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# RFC 9274

## A Cost Mode Registry for the Application-Layer Traffic Optimization (ALTO) Protocol

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### Abstract

This document creates a new IANA registry for tracking cost modes supported by the Application-Layer Traffic Optimization (ALTO) Protocol. Also, this document relaxes a constraint that was imposed by the ALTO specification on allowed cost mode values.

This document updates RFC 7285.

### Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 7841.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at <https://www.rfc-editor.org/info/rfc9274>.

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## 1. Introduction

The cost mode attribute indicates how costs should be interpreted when communicated as described in "Application-Layer Traffic Optimization (ALTO) Protocol" [RFC7285], which includes a provision for only two modes:

"numerical": Indicates that numerical operations can be performed (e.g., normalization) on the returned costs (Section 6.1.2.1 of [RFC7285]).

"ordinal": Indicates that the cost values in a cost map represent ranking (relative to all other values in a cost map), not actual costs (Section 6.1.2.2 of [RFC7285]).

Additional cost modes are required for specific ALTO deployment cases (e.g., [ALTO-PV]). In order to allow for such use cases, this document relaxes the constraint imposed by the base ALTO specification on allowed cost modes (Section 3) and creates a new ALTO registry to track new cost modes (Section 5).

The mechanisms defined in [RFC7285] are used to advertise the support of new cost modes for specific cost metrics. Refer to Section 4 for more details.

## 2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

This document makes use of the terms defined in [RFC7285].

## 3. Updates to RFC 7285

### 3.1. Updates to Section 6.1.2 of RFC 7285

This document updates Section 6.1.2 of [RFC7285] as follows:

OLD:

The cost mode attribute indicates how costs should be interpreted. Specifically, the cost mode attribute indicates whether returned costs should be interpreted as numerical values or ordinal rankings.

It is important to communicate such information to ALTO clients, as certain operations may not be valid on certain costs returned by an ALTO server. For example, it is possible for an ALTO server to return a set of IP addresses with costs indicating a ranking of the IP addresses. Arithmetic operations that would make sense for numerical values, do not make sense for ordinal rankings. ALTO clients may handle such costs differently.

Cost modes are indicated in protocol messages as strings.

NEW:

The cost mode attribute indicates how costs should be interpreted. Two cost modes (numerical values and ordinal rankings) are defined, but additional cost modes can be defined in the future.

It is important to communicate such information to ALTO clients, as certain operations may not be valid on certain costs returned by an ALTO server. For example, it is possible for an ALTO server to return a set of IP addresses with costs indicating a ranking of the IP addresses. Arithmetic operations that would make sense for numerical values, do not make sense for ordinal rankings. ALTO clients may handle such costs differently.

Cost modes are indicated in protocol messages as strings.

For any future documents that defines a new cost mode, indicating whether that new cost mode applies to all or a subset of cost metrics is strongly recommended. This recommendation is meant to prevent nondeterministic behaviors that may result in presenting a cost mode with a specific metric, while such an association does not make sense or can't be unambiguously interpreted by ALTO implementations.

If the definition of a cost mode does not indicate whether that cost mode applies to a subset of cost metrics, ALTO implementations **MUST** be prepared to accept that cost mode for any cost metric.

### 3.2. Updates to Section 10.5 of RFC 7285

This document updates [Section 10.5](#) of [\[RFC7285\]](#) as follows:

OLD:

A cost mode is encoded as a string. The string **MUST** have a value of either "numerical" or "ordinal".

NEW:

A cost mode is encoded as a string. The string **MUST** be no more than 32 characters, and it **MUST NOT** contain characters other than US-ASCII alphanumeric characters (U+0030-U+0039, U+0041-U+005A, and U+0061-U+007A), the hyphen-minus ('-', U+002D), the colon(':', U+003A), or the low line ('\_', U+005F). Cost modes reserved for Private Use are prefixed with "priv:" ([Section 5](#)). Otherwise, the cost mode **MUST** have a value that is listed in the registry created in [Section 5](#) of [\[RFC9274\]](#).

## 4. Backward Compatibility Considerations

ALTO servers that support new cost modes for specific cost metrics will use the mechanism specified in [Section 9.2](#) of [\[RFC7285\]](#) to advertise their capabilities. ALTO clients (including legacy) will use that information to specify cost constraints in their requests (e.g., indicate a cost metric and a cost mode). An example of such a behavior is depicted in [Section 9.2.3](#) of [\[RFC7285\]](#).

If an ALTO client includes a cost mode that is not supported by an ALTO server, the server indicates such an error with the error code E\_INVALID\_FIELD\_VALUE as per [Section 8.5.2](#) of [\[RFC7285\]](#). In practice, legacy ALTO servers will reply with the error code E\_INVALID\_FIELD\_VALUE to requests that include a cost type other than "numerical" or "ordinal" for the "routingcost" cost metric.

The encoding constraints in [Section 3.2](#) do not introduce any interoperability issue given that currently implemented cost modes adhere to these constraints (mainly, those in [\[RFC7285\]](#) and [\[ALTO-PV\]](#)).

## 5. IANA Considerations

IANA has created the new "ALTO Cost Modes" subregistry within the "Application-Layer Traffic Optimization (ALTO) Protocol" registry available at [ALTO].

The assignment policy for this subregistry is "IETF Review" (Section 4.8 of [RFC8126]).

Requests to register a new ALTO cost mode must include the following information:

**Identifier:** The name of the ALTO cost mode. Refer to Section 3.2 for more details on allowed encoding.

**Description:** A short description of the requested ALTO cost mode.

**Intended Semantics:** A reference to where the semantic of the requested cost mode is defined.

**Reference:** A reference to the document that registers the requested cost mode.

Cost modes prefixed with "priv:" are reserved for Private Use (Section 4.1 of [RFC8126]). IANA has added the following note to the new subregistry:

Identifiers prefixed with "priv:" are reserved for Private Use (see RFC 9274, Section 5).

The subregistry is initially populated with the following values:

Identifier	Description	Intended Semantics	Reference
numerical	Indicates that numerical operations can be performed on the returned costs	Section 6.1.2.1 of [RFC7285]	RFC 9274
ordinal	Indicates that the cost values in a cost map represent ranking	Section 6.1.2.2 of [RFC7285]	RFC 9274

Table 1: ALTO Cost Modes

## 6. Security Considerations

This document does not introduce new concerns other than those already discussed in Section 15 of [RFC7285].

## 7. References

### 7.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <<https://www.rfc-editor.org/info/rfc2119>>.
- [RFC7285] Alimi, R., Ed., Penno, R., Ed., Yang, Y., Ed., Kiesel, S., Previdi, S., Roome, W., Shalunov, S., and R. Woundy, "Application-Layer Traffic Optimization (ALTO) Protocol", RFC 7285, DOI 10.17487/RFC7285, September 2014, <<https://www.rfc-editor.org/info/rfc7285>>.
- [RFC8126] Cotton, M., Leiba, B., and T. Narten, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 8126, DOI 10.17487/RFC8126, June 2017, <<https://www.rfc-editor.org/info/rfc8126>>.
- [RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <<https://www.rfc-editor.org/info/rfc8174>>.

## 7.2. Informative References

- [ALTO] IANA, "Application-Layer Traffic Optimization (ALTO) Protocol", <<https://www.iana.org/assignments/alto-protocol/>>.
- [ALTO-PV] Gao, K., Lee, Y., Randriamasy, S., Yang, Y. R., and J. J. Zhang, "An ALTO Extension: Path Vector", Work in Progress, Internet-Draft, draft-ietf-alto-path-vector-25, 20 March 2022, <<https://datatracker.ietf.org/doc/html/draft-ietf-alto-path-vector-25>>.

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